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A STUDY OF THE OUTPUT OF WORKERS UNDER A PARTICULAR WAGE-INCENTIVE

Purpose of the investigation.—Much is being said and written nowadays about the motives that animate industrial workers. Long lists of incentives are postulated: individual instinctive ones, such as acquisitiveness, constructiveness, workmanship; social instinctive ones, such as leadership, rivalry, imitation; Freudian ones, such as suppressed desires for self-expression, repressed loves and hates, etc.¹ These attempts at enumeration and classification are defective in that they picture incentives as being veritable entities and as having existential singularity.

True, it must be admitted that there are things that serve as incentives to workers. They characteristically operate, however, in a concrete setting, and their results are the outcome of a complex situation. To describe them one cannot blandly hypothesize them as bare abstract forces; one must instead (1) delineate them concretely in their work-setting, and (2) measure their effects in work-terms.

In order to realize these aims, a manufacturing establishment was entered where workers were motivated by a thoroughly planned system of wage-payment, and where the accurately kept records of individual performance enabled the psychologist to measure the effects of the incentive over a considerable period of time.

Material and method.—The data used in the investigation consist of the records of output of forty experienced hand compositors who were hired (at intervals) during the years 1918 and 1919, and who remained at least until January, 1921. There were others hired during this period, but their records are not included, being incomplete in one respect or another. The pro-

¹ See Carleton Parker, *The Casual Laborer*, New York, Harcourt, Brace & Co., 1920; Thorstein Veblen, *The Instinct of Workmanship*, New York, Macmillan, 1914.

duction records of these men were kept during the first twenty weeks of their employment and were tabulated again at three months' intervals from October, 1920, to July, 1921.

The scale upon which the output was measured is the product of a rather complicated task-setting process involving the preliminary determination, by means of time-studies, of the number of lines (of each kind of matter) that an expert compositor could set in an hour. This was then considered as the level of 100 per cent efficiency. Seventy-five per cent on this scale was taken as a standard that might be regarded as a fair day's work, and every compositor was paid a flat hourly rate whether he reached this 75 per cent point or not. But he was told that as soon as he exceeded it he would receive an additional sum—two-thirds of 1 per cent (of the flat rate) for every unit on the scale. For example, for reaching the 85 per cent mark he would receive a premium amounting to $6\frac{2}{3}$ per cent of the flat rate; for reaching the 100 per cent mark, a sum amounting to 16.5 per cent of the flat rate. He might even exceed the 100 per cent mark, as may be seen in Table I, for all of which he would be paid the corresponding premium. (It might be stated that the establishment is a non-union plant paying wages higher than the established union rates.)

Here were conditions favorable to the investigation of incentives—an incentive defined in concrete terms, and an arrangement for measuring the output that it was designed to affect. From the data thus obtained may be answered several questions of concern to practical industrial management and to psycho-economic theory. The results will be presented in terms of the answers to these questions: Did the output increase under this system of wage-payment? If so, to what extent? How soon did the output rise to the 75 per cent mark? What was the rate of increase thereafter? What was the maximum point of efficiency reached? When was it reached? Did the compositors with relatively long experience make greater improvement than those with less experience?

Results.—In answer to the first two of these questions, the results show a decided increase in output. Table I and Figure 1

show that from an average of fifty-nine at the end of the first week the output increased to 105, or 78 per cent.

TABLE I

SHOWING AGE, YEARS OF PREVIOUS EXPERIENCE, AND PER CENT OF EFFICIENCY REACHED BY EACH COMPOSITOR AT VARIOUS INTERVALS

Compositor	Age	Years Ex- per- ience	Number of Weeks on the Job						Oct. 1920	Jan. 1921	Apr. 1921	July 1921
			1	4	8	12	16	20				
I...	29	14	39	73	100	119	131	149	94	100	94	93
II...	29	6	50	75	98	95	104	138	114	116	.....	.....
III...	25	5	57	108	99	112	124	128	84	109	107	110
IV...	38	.....	41	78	95	117	116	119	69	80	.....	.....
V...	41	16	64	127	114	128	134	119	114	122	107	121
VI...	24	6	49	97	87	100	108	118	134	132	132	129
VII...	23	8	46	45	82	103	95	118	99	103	.....	.....
VIII...	26	6	70	111	115	110	112	115	119	108	109	109
IX...	25	7	82	70	101	104	115	115	113	102	.....	.....
X...	29	12	92	94	99	104	109	110	111	117	.....	.....
XI...	39	7	54	94	76	93	102	110	109	109	113	106
XII...	25	4	54	75	89	120	102	110	113	108	120	107
XIII...	31	8	55	50	72	77	80	104	108	96	109	103
XIV...	35	8	78	80	87	78	80	104	80	81	89	86
XV...	44	27	43	71	66	76	91	104	80	87	90	109
XVI...	29	9	71	96	107	125	113	102	118	107	.....	.....
XVII...	32	16	69	55	72	90	85	101	83	82	.....	.....
XVIII...	.....	11	102	105	112	100	99	100	105	107	.....	.....
XIX...	31	11	78	92	95	91	96	100	106	99	104	100
XX...	39	.....	53	65	83	92	96	99	.....	54	.....	.....
Total....	594	181	1,247	1,661	1,849	2,034	2,092	2,263	1,954	2,019	1,174	1,173
Average..	31.2	10.0	62.3	83.0	92.5	101.7	104.6	113.2	102.8	100.9	106.7	106.6
XXI...	45	20	54	59	66	83	101	98	.....	90	.....	.....
XXII...	32	7	50	96	113	104	111	97	107	105	111	109
XXIII...	36	15	63	99	103	98	105	92	107	103	.....	.....
XXIV...	36	.....	44	72	84	79	80	91	108	96	.....	.....
XXV...	23	6	52	86	107	91	80	90	115	115	115	105
XXVI...	39	7	61	93	80	81	94	90	86	81	85	86
XXVII...	29	9	52	76	75	93	92	89	110	97	103	103
XXVIII...	35	8	80	46	60	106	114	88	105	102	108	110
XXIX...	30	10	62	50	52	60	64	87	.....	100	.....	.....
XXX...	40	10	77	71	80	87	95	86	110	109	.....	.....
XXXI...	39	20	80	54	65	81	84	82	.....	91	85	89
XXXII...	28	9	44	60	54	47	53	79	98	90	87	100
XXXIII...	25	.....	73	105	94	100	112	79	113	103	111	109
XXXIV...	24	8	54	84	95	96	83	78	85	86	.....	.....
XXXV...	39	21	49	63	59	79	114	74	75	66	.....	.....
XXXVI...	37	17	39	47	64	62	64	72	.....	92	.....	.....
XXXVII...	49	11	56	57	44	55	76	71	88	73	73	73
XXXVIII...	30	6	50	58	75	71	79	70	95	73	.....	.....
XXXIX...	18	1	26	40	20	41	41	63	.....	55	.....	.....
XL...	29	5	42	43	50	56	76	51	119	108	107	103
Total....	663	190	1,108	1,359	1,440	1,570	1,718	1,627	1,621	1,837	998	989
Average..	33.2	10.6	55.4	67.9	72.0	78.5	85.9	81.3	81.9	91.9	99.8	98.9
Grand total...	1,257	371	2,355	3,020	3,289	3,604	3,810	3,990	3,574	3,856	2,162	2,162
Grand average.	32.2	10.3	58.8	75.5	82.2	90.1	95.3	97.3	105.7	96.4	103.2	102.9

(It might be interposed here that the work of new employees might be expected to improve as they became used to working in a new plant, quite apart from any unusual wage incentive.

Probably this cannot be denied. This report constitutes merely a portrayal of the output of this particular group of workers under the conditions described. It is presented as a pattern

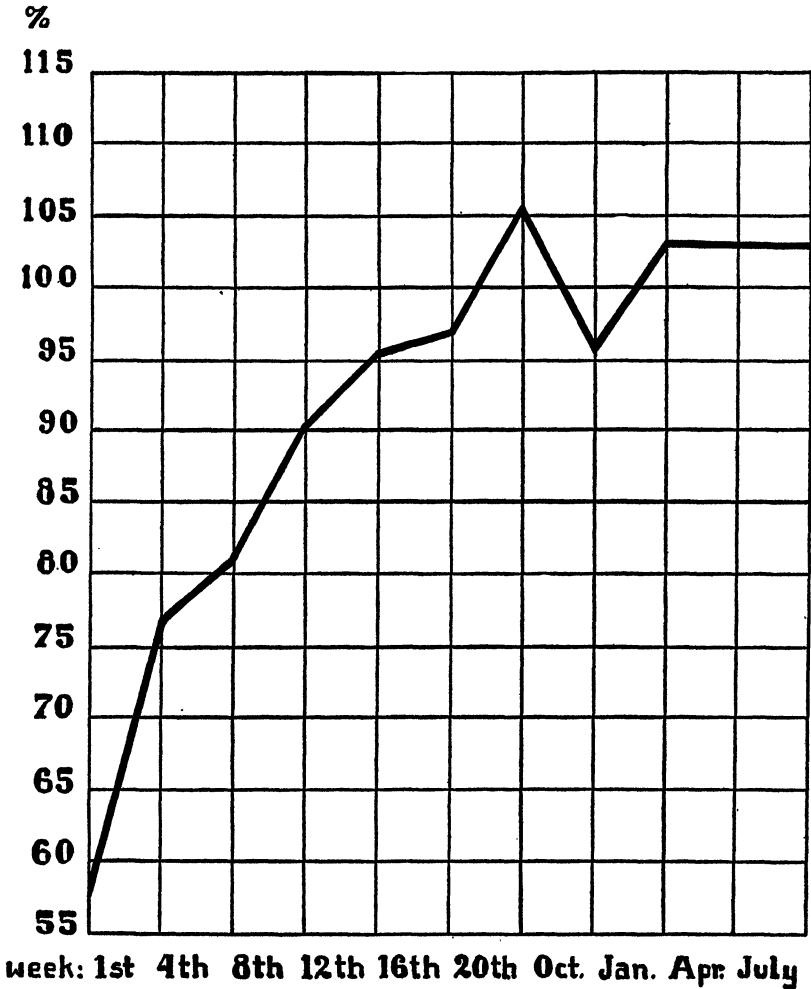


FIG. 1

according to which the influence of incentives upon industrial workers may be approached experimentally instead of speculatively.)

Not only did the average output increase, but the individual output also increased in every case during the first twenty weeks, except that of Compositor XVIII, which diminished two units on the scale of efficiency (though it should be remarked that this worker started with 102, the highest initial record). The amounts of increase during this period range from 2 (XXXI) to 110 (I) with an average of 38.9 (A.D. 19.3). Thirty-four or 85 per cent of the 40 reached the 75 per cent mark during their first twenty weeks. Measures taken later show that all but one (XXXIX) attained the required standard at some time or other.

The average output reached the 75 per cent mark at the end of the fourth week. Inspection of the progressive amounts of output showed nothing to be gained for the purposes of this investigation by considering the output of every week; and so only the measures of every fourth week are presented. The average amounts gained at each of these periods are shown in terms of units on the scale of efficiency, and in terms of per cent of increment, in Table II. The greatest increments occurred

TABLE II
SHOWING AMOUNTS OF GAIN AT FOUR-WEEK
INTERVALS

Interval	Units	Per Cent Increment
First to fourth week.....	17	28
Fourth to eighth week.....	7	8
Eighth to twelfth week.....	10	12
Twelfth to sixteenth week.....	2	2
Sixteenth to twentieth week.....	2	2

in the order: fourth week, twelfth week, eighth week, sixteenth week, twentieth week. And, as will be seen in Table I and Figure 1, another level of increase was registered October 31, 1920.

As shown in Table I and Figure 1, the maximum average point is 105. This is the record for October 31, 1920. Exactly how long this was after the initial employment varies according to the dates at which the various individuals were employed, during the years 1918 and 1919.

The tale told by these average amounts, however, when scrutinized closely, is found to misrepresent conditions. For on the basis of their output at the end of their twentieth week

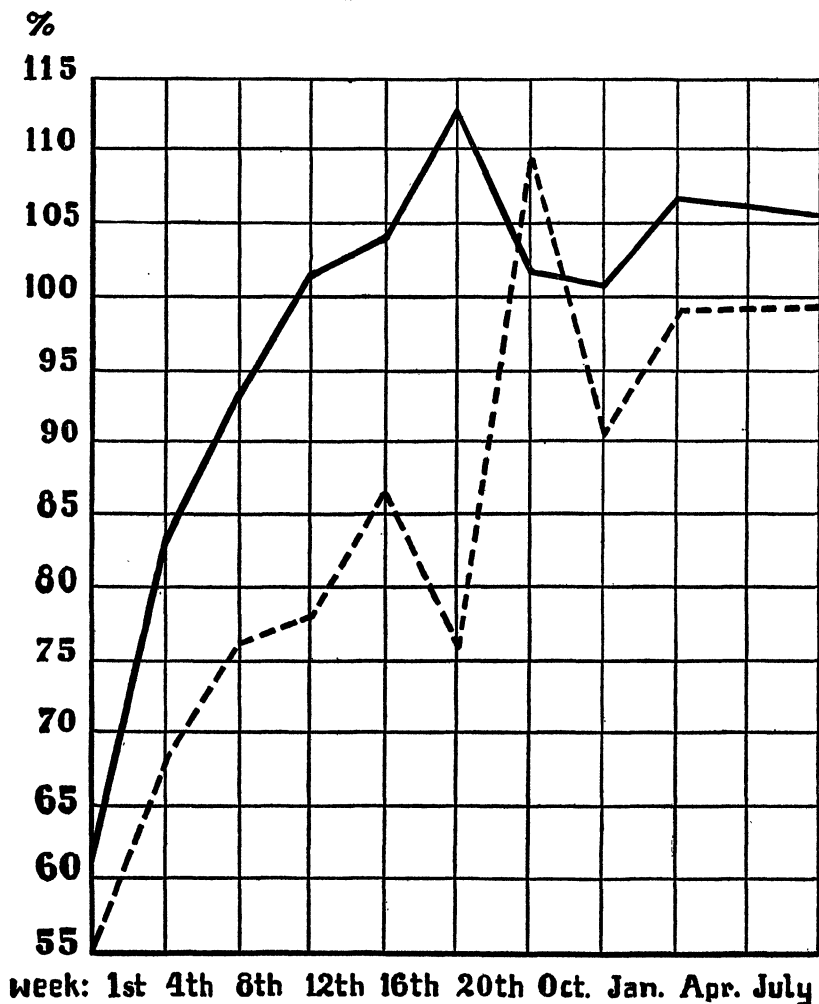


FIG. 2

of service (see Table I) the composers were divided into two groups. Averages computed for each of these groups show that the two followed similar courses (see Fig. 2), but on widely

separated levels of efficiency. The better group began at 62.3 and closed the twentieth week at 113.2; the other began at 55.4 and closed the twentieth week at 81.3; the two groups gaining during the period, 51 units (82 per cent) and 26 units (47 per cent) respectively.

After the twentieth week the performances of these two groups showed further differences. The group that had turned out the most work and had made the greatest gain now began to turn out less work; while the other group continued to gain. As shown in Table III, by October 31, 1920, only eight of the upper

TABLE III
SHOWING GAINS AND LOSSES COMPARED WITH RECORDS OF THE
TWENTIETH WEEK

GROUP	GAINS				LOSSES			
	October 31, 1920		January 31, 1921		October 31, 1920		January 31, 1921	
	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.
Upper half.....	8	5.6	5	7.2	12	22.6	15	19.1
Lower half.....	14	17.8	16	15.1	1	4	4	8.3

twenty were still gaining (with an average of 5.6 units); while of those in the lower half (only fifteen of the twenty records are complete) fourteen gained an average amount of 17.8. By January 31, 1921, these differences were accentuated. Of those composers in the upper half only five gained, with an average gain of 7.2; while of the twenty in the lower half, sixteen gained, on the average, 15.1. The records thereafter show the same relative positions.

To compute the amounts lost is also revelatory. The composers in the upper half lost an average amount of 22.6 by October, 1920; 19.1 by January, 1921; while those in the lower half who lost had lost only 4 units and 8.3 units by these two dates.

To explain the curve of the lower group with its relatively low beginning and its slow ascent during the first twenty weeks, we may infer that the members of this group were the less adapt-

able ones of the compositors. Why their output kept on increasing after that of the upper half had ceased to increase may be:

1. Because the effect of the premium was still operating with them until October, 1920.

2. Again, they may have been spurred on by the example of the upper group so far above them.

3. It might be supposed that the lower group kept on gaining because they had had less experience in the trade and thus had more to learn than the others. This supposition is belied, however, by two facts: (a) that they started only seven points below the others, surely not great enough handicap to account for the great difference of thirty-two at the twentieth week; and (b) that according to the records (see Table I) the two groups had had the same average number of years experience—ten.

To explain why the work of the superior half diminished in quantity after the twentieth week with its average record of 113.2, requires more complex hypotheses. Four guesses may be hazarded:

1. Though the premium was high enough to stimulate these workers to a plane of 113.2, it was not strong enough to keep them there. Its power as a stimulating force may have died down with the passage of time, much as does the power of a simple sensory stimulus in the common phenomenon of sensory adaptation. Or, the members of the group may have concluded, overtly or not, that the reward was not worth the effort required to keep the output at the 113.2 mark. Experience as reported by Marot¹ seems to favor this view: "As fair or as superior as the bonus may be in relation to the prevailing rate in the market, managers say that the workers are apt in time to fall below the standard as their work becomes routine, unless the incentive after a time is increased or changed in character. In other words, the wage incentive is like a virus injection. The dose is not continuously effective, except as the amount is increased or altered."

2. It is conceivable that by the twentieth week the upper group had reached the highest level they were physiologically

¹ Helen Marot, *The Creative Impulse in Industry*, New York, E. P. Dutton & Company, 1918, p. 50.

capable of attaining, and one too high to maintain indefinitely; that nature forced the succeeding drops. This appears rather likely from the fact that the lower group also decreased their output slightly after reaching their peak of October, 1920.

3. An outsider might suggest that perhaps as the upper group became quickly proficient, they were given slightly more difficult grades of work on which they could not work so fast. This explanation does not have much weight, however, since all the jobs in the department were prorated in difficulty, and the units in which the output was measured were always the same—standard-hours based upon accurate time-studies.

4. In the opinion of the writer there is strong likelihood that we have here an interesting form of “stereotyping of output,”

that is, a form of output in which the same individual or group of individuals will turn out day after day and week after week practically the same quantity of finished product. In one munition factory engaged in the manufacture of fuses a large proportion of the force was thus working. In forming at a capstan lathe the large end of the fuse, one man finished exactly 1000 pieces on each of 44 nights out of 45 that were observed; in gauging the fuses five girls out of six that were studied for one week, examined 1315 fuses each day. . . . If work were stopped for a brief period for reasons beyond the power of the worker to control, such as the temporary crippling of a machine, the stoppage was likely to be followed by a spurt and, without overworking his powers, the worker finished the day with the usual production to his credit. . . . In the factory mentioned piece-rates were paid, and the worker by doing more could earn more wages, and yet he limited his work.^{*}

It is thus possible that these forty compositors tacitly decided that an average output near 100 was good enough. All worked hard until they reached it. Some (the upper half) reached it quickly, and certain ones of these far exceeded it, having perhaps higher ideals regarding output, or having greater powers. The lower half approached 100 less rapidly; but as they reached it the upper half reduced their output (so as to keep the average around 100?). It is significant that the average remains at 102, just above the point which, the management say, is regarded

^{*} Frederic S. Lee, *The Human Machine and Industrial Efficiency*, New York, Longmans Green & Company, 1919, pp. 40 ff.

by the workers as the point below which they might be discharged in time of slack work.

One cause that has been ascribed to this phenomenon of "stereotyping of output" is the practice that prevails at some industrial plants, of lowering the piece-rate or raising the standard task required when, in the opinion of the management, the worker is earning too high wages. The fear of this happening could not have been operative in the present instance, however, because the management has made a rule, to which it adheres scrupulously, that a rate once established will never change.

It now remains to discover the influence of former experience upon individual output. The question may be stated, Did the compositors with long experience develop greater output than those with less experience? Table IV shows that the years of experience of the thirty-six men whose experience could be determined at time of this writing, ranged between 1 and 27. The median was between 8 and 9, A.D. 4. The average for the more experienced half is 14.3; that for the less experienced half, 6.1. The eighteen men above the median in experience, though starting at a relatively high plane of output (63), reached by the twentieth week, by October, 1920, and by January, April, and July, 1921, respectively, 95, 99, 97, 93, and 99. The eighteen with less than median experience, while starting at only 56, achieved average outputs for the above-named periods of 99, 105, 105, 109, and 105.

We may conclude, therefore, that those with longer experience did not, because of it, turn out more work. Indeed they did not turn out as much work as those with less experience. (See Table IV and Fig. 3.) The explanation may be that they were older and consequently slower in movement, being on the average 37.7 years old, while those of less experience averaged 28.5 years. More likely, however, they were simply more firmly settled in habits of work, some of which were undoubtedly inefficient. Those with less experience did not have their bad habits so firmly established, and they could make changes in method with greater ease.

In short, there seems here to be strong indication that the greatest part of the increase in output on the part of all these forty compositors came about through the elimination of wasteful methods and the acquisition of economical methods of work.

TABLE IV
SHOWING OUTPUT IN RELATION TO YEARS OF EXPERIENCE
(Thirty-six Men)

Compositor	Age	Years Ex- peri- ence	Number of Weeks on the Job						Oct. 1920	Jan. 1921	Apr. 1921	July 1921
			1	4	8	12	16	20				
XV	44	27	43	71	66	76	91	104	80	87	90	109
XXXV	39	21	49	63	59	79	114	74	75	66	.....	.....
XXI	45	20	54	59	60	83	101	98	.....	90	.....	.....
XXXI	39	20	80	54	65	81	84	82	.....	91	85	89
XXXVI	37	17	39	47	64	62	64	72	.....	.....	.....	.....
XVII	32	16	69	55	72	90	85	101	83	82	.....	.....
V	41	16	64	127	114	128	134	119	114	122	107	121
XXIII	36	15	63	99	103	98	105	92	107	105	.....	.....
I	29	14	39	73	100	119	131	149	94	95	94	93
X	29	12	92	94	99	104	109	110	111	117	.....	.....
XVIII	.....	11	102	105	112	100	99	100	105	107	.....	.....
XIX	31	11	78	92	95	91	96	100	106	107	.....	.....
XXXVII	49	11	56	57	44	55	76	71	88	99	104	100
XXX	40	10	77	71	80	87	95	86	110	109	73	75
XXXI	30	10	62	50	52	60	64	87	.....	110	.....	.....
XXXII	28	9	44	60	54	47	53	79	98	90	87	100
XVI	29	9	71	96	107	125	113	102	118	107	.....	.....
XXXVII	29	9	52	76	75	93	92	89	110	97	103	103
Total	607	258	1,134	1,349	1,427	1,578	1,706	1,715	1,399	1,739	743	700
Average	35.7	14.3	63.0	74.9	79.3	87.7	94.8	95.3	99.9	90.7	92.9	98.8
VII	23	8	46	45	82	103	95	118	99	103	.....	.....
XIII	31	8	55	50	72	77	80	104	108	96	109	103
XIV	35	8	78	80	87	78	80	104	80	81	89	86
XXVIII	35	8	80	46	60	106	114	88	105	102	102	110
XXXIV	24	8	54	84	95	96	83	78	85	86	.....	.....
XI	39	7	54	94	70	93	102	110	109	109	113	106
XXII	32	7	50	96	113	104	111	97	107	105	111	109
IX	25	7	82	70	101	104	115	115	113	102	.....	.....
XXVI	39	7	61	93	80	101	94	90	86	81	88	86
XXXVIII	30	6	50	58	75	71	79	70	95	73	.....	.....
VI	24	6	49	97	87	100	108	118	134	132	132	129
II	29	6	50	75	98	95	104	138	114	116	.....	.....
XXV	23	6	52	86	107	91	80	98	115	115	115	105
VIII	26	6	70	111	115	110	112	115	119	108	109	106
III	25	5	57	108	99	112	124	128	84	109	107	110
XL	29	5	42	43	80	56	76	51	119	108	107	103
XII	25	4	54	75	89	120	102	110	113	108	120	107
XXXIX	18	1	26	40	20	41	41	63	.....	55	.....	.....
Total	513	113	1,010	1,351	1,506	1,638	1,700	1,787	1,785	1,789	1,308	1,260
Average	28.5	6.3	56.1	75.0	83.7	91.0	94.4	99.3	105.0	105.2	109.0	105.0

The curves, both that showing the average scores for the entire group (Fig. 1) and those showing the average scores for the two halves (Fig. 2), show the characteristics usually ascribed to typical learning curves: irregularity, plateaus, relatively long period of time to develop, and ultimate stability.

The results suggest that in so far as such a wage premium is considered as a tool for the stimulation of increased output it should not be regarded as an incentive-device that will make the



FIG. 3

worker increase his output solely by exerting sudden efforts of will. If such were the case, the output would be expected to rise to its maximum immediately upon application of the pre-

mium offer. In spite of supposedly vigorous efforts, however, these workers did not reach their maximum output for many months indicating that something was needed besides sheer effort of will; that what occurred, indeed, was the elimination of obstructive movements and the invention of more effective methods. (As already shown, those with long experience did not improve as much as did those of shorter experience who were less heavily cumbered with deep-seated inefficiencies.)

It follows, therefore, that the charge voiced by some spokesmen of labor,¹ that premium-incentives and other "speeding-up" devices are wrong because they bring increased output at the expense of the worker's health, is not wholly justified. The fact that these compositors maintained the level finally attained throughout the two years covered by this investigation is surely some indication that they were not seriously overtaxing themselves. The truth probably is that they did the more efficient work with less physical fatigue than they did the early less efficient work.

Conclusions and summary.—1. Under the conditions of work obtaining in this plant, the compositors observed, although having on the average ten years of experience before entering this plant, improved markedly under the system of wage-payment described—improved individually and *en masse*.

2. The amounts of improvement varied during the first twenty weeks between two and fifty-five units on the scale of efficiency, with an average of thirty-nine units or 67 per cent.

3. The rate of improvement was irregular, the greatest increase during any of the four-week periods occurring during the first four weeks; the next greatest, during the third four-week period.

4. The average output reached the 75 per cent mark at the end of the fourth week; reached the highest peak on October 31, 1920; then fell back to what appears to be a permanent level at 102.

5. The group appears to have been composed of two rather distinct types: one group of twenty who increased their output

¹ Robert F. Hoxie, *Scientific Management and Labor*, New York, D. Appleton & Company, 1915, pp. 170 ff.

rapidly during the first twenty weeks, reaching a maximum of 113, and then falling down to an average output of 107; another group of twenty who increased their output more slowly (to a maximum of 109 in October, 1920); and then found a level of 99. Various factors may have contributed to these differences:

a) Those in the first-mentioned group may have been the more freely adaptable of the compositors.

b) The reason they lessened their output below the maximum of the twentieth week may be that they did not see enough reward in the premium to repay them for making the effort necessary to maintain the maximum.

c) Again it is possible that the maximum—113.2—was above the physiological level that could be maintained with comfort.

d) Those in the slower group may have been stimulated to increase their output longer than the others, by the example of the others.

6. The records give strong indication that many, and probably all, of these workers, wittingly or unwittingly participated in a "stereotyping of output"; that though capable of doing a larger amount of work, they endeavored to do just enough, as one manager put it, "to remain safely above the 100 percentage efficiency mark and thus insure that they would not be among those discharged during periods of slack work."

7. Long experience is not necessarily associated with high output. The less experienced half of these workers made higher ultimate records and greater relative gains than did the more experienced ones, the reason ascribed being that the former possessed fewer harmful habits to be eradicated.

8. Finally, this analytical study of output gives basis for a revision of the current conception of industrial incentive:

a) An industrial incentive is not necessarily a brutal whip which, for the sake of swelling an employer's profits, goads a workman to labor to his own detriment. Instead, it may be a beneficent device that leads the worker to produce more by eliminating wasteful movements and substituting time and effort-saving movements, certainly with financial profit to himself and probably with less weariness than under the old methods.

b) An incentive seems to reach a point where it ceases to evoke further increase in output. It may lose further stimulating power as does a stimulus in the phenomenon of sensory adaptation; it may lead the worker to reach a true physiological level; or it may encounter the phenomenon described as "stereotyping of output." Probably it is subject to the influence of all these factors.

c) An industrial incentive should be regarded as a concrete thing rather than as an abstract entity; to be defined in exact terms, and described in its actual setting which is composed of various influences, physiological, social, etc.

d) To be truthfully described, its results must be stated in quantitative terms. Speculation only leads to futile wandering and confusion. Only by the slow and painstaking observation of workers and the collection of records of actual output can we arrive at an understanding of the way in which an industrial incentive affects a worker.

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